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A DEVICE FOR CONTACTING IN PARTICULAR ELONGATED, ILLUSTRATIVELY SUBSTANTIALLY CYLINDRICAL BODIES SUCH AS CABLES OR PIPES/TUBES

Field of the Invention

The present invention relates to a device for contacting, in particular, elongated, illustratively substantially cylindrical bodies such as cables or pipes or tubes, where hereafter the word "pipe" also includes the meaning of "tube".

Background of the Invention

A device of the above kind is known from the European patent document A 0 744 788. It is used to set up an electrically conducting connection between a pipe or a bared outer conductor of a coaxial cable and a conductor, for instance a grounding cable. The known device comprises a base structure in the form of a clamp, this base structure being fitted with a band-shaped metal part imbedded in an elastic material, for instance rubber, forming sealing lips mutually spaced in the axial direction of the base structure. The sealing lips are fitted with rest surfaces by means of which, in the assembly position, the base structure rests against the body to be contacted, the sealing lips sealing a space, which in the

assembly position is subtended between the base structure and the body to be contacted, against penetration of air and/or moisture. Moreover the known device comprises contact means to implement an electrically conducting connection between the body to be contacted and a conductor, for instance a grounding cable. In the known device, the contact means consist of a separate adapter in the form of a band copper braid resting, in the assembly position, on one hand against the body to be contacted and on the other hand against the side of the band-shaped metal part of the base structure facing the body to be contacted. The adapter is joined to the base structure adhesively or by spot welds.

The known device incurs a drawback in that its manufacture entails connecting the separate adapter in an additional operational stage to the base structure and therefore being laborious and costly. This device suffers from a further drawback in that spot bonding between the adapter and the base structure carries the danger that the adapter may slip when being connected to the base structure during manufacture and accordingly will not be affixed in the desired position to the base structure. If so, the assembly of the device of the invention may require detaching the adapter from the base structure to move it into the desired position. Such a procedure is laborious and raises assembly costs. Moreover the connection implemented solely by spot welds raises the danger that the adapter may come loose off the base structure and be lost. In such a case, before the known device will be assembled, a new adapter must be secured,

entailing complexity and increasing both material and assembly costs.

Objects and Summary of the Invention

The objective of the invention is to create a device defined in the preamble of claim 1 which shall be free of the drawbacks of the known device, that is, which shall allow simple and economical manufacture and installation.

The disclosure of the invention abandons the concept of forming the contact means implementing an electrically conducting connection between the body to be contacted and a conductor, for instance a grounding cable, by means of a spot-bonded adapter. Instead the concept of the invention is to constitute the contact means by part of the base structure. For that purpose the invention provides that the base structure comprise at least one contact protrusion made of an electrically conducting material. A separate adapter, illustratively consisting of band copper braid, therefore no longer is required and as a result the manufacture of the device of the invention is simpler and more economical.

The contact means being formed by part of the base structure, there is no danger either it might be lost as there is for the known devices.

The shape, size and position of the -- or each -- contact protrusion can be selected within wide limits according to particular requirements. The number of contact protrusions as well can be selected within wide limits. In a variant of the invention, the -- or each -- contact

protrusion consists of an element firmly bonded to the base structure. Illustratively the -- or each -- contact protrusion may be a sheetmetal firmly joined to the sheetmetal of the base structure by welding and projecting from the base structure toward the body to be contacted. Because of the thorough bonding of the contact-protrusion forming part to the base structure, this part is unshakably held at the base structure. Welding allows thoroughly bonding the two components in simple and economic manner and as a result the manufacturing costs of the device of the invention are low.

Essentially the -- or each -- contact protrusion may be made of an arbitrary, electrically well conducting material as long as the contact protrusion when in the assembly position between the body to be contacted and an electrically conducting conductor connected to the contact protrusion, for instance a grounding cable, be sufficiently conducting to assure shunting any currents, for instance from lightning, through the grounding cable. In order to minimize as much as possible the electrical resistance of the contact protrusion, the -- or each -- contact protrusion shall appropriately be metallic.

In an unusually advantageous embodiment of the invention, the -- or each -- contact protrusion is integral with the base structure or part thereof. In this manner a separate component no longer is required to constitute the contact means. This feature substantially simplifies manufacturing the device of the invention and makes it accordingly more economical.

In a further embodiment, the -- or each -- contact protrusion is elastically deforming in such manner that in the assembly position it will rest in resilient manner against the electrically conducting part of the body to be contacted. An especially reliable electrical connection is achieved in this embodiment on account of the resilient application of the contact protrusion against the electrically conducting part of the body to be contacted. Furthermore the resilient application of the -- or each -- contact protrusion will compensate for component tolerances.

In one embodiment of the invention, the electrically conducting connection of the -- or each -- contact protrusion and the body to be contacted can be further improved by springs biasing the -- or each -- contact protrusion toward the body to be contacted.. By appropriately selecting the spring bias, the force with which the -- or each -- contact protrusion in the assembly position rests against the body to be contacted can be selected within wide limits to meet the particular requirements.

In principle the base structure can be made substantially rigid. However an appropriate variant provides that the base structure be flexible. In this variant the base structure follows, on account of its flexibility, the surface of the body to be contacted. This feature also allows contacting strongly non-planar or curved bodies. The bodies to be contacted may be arbitrary, for instance they may be planar, bar-shaped, arbitrarily bent or curved or tubular and of arbitrary cross-section.

In another embodiment, the base structure comprises a band-shaped or plate-shaped contact element made of an electrically conducting material, preferable a metal. In variants of the above embodiment, the base structure is fitted at its side facing the body to be contacted in the assembly position with at least one protrusion at which the contact element is held and thereby forms the contact protrusion, or the -- or each -- contact protrusion is formed at the side of the contact element facing the body to be contacted in the assembly position.

In another, especially advantageous variant of the above embodiment, the - or each -- contact protrusion consists of an embossing in the contact element. If illustratively the contact element is a metal band, the metal band can be appropriately embossed to form the -- or each -- contact protrusions. This is a simple design and can be manufactured economically. The shape and size of the contact protrusion can be selected within wide limits by appropriately embossing the metal band.

In a variant of the above embodiment, the -- or each - embossing consists of a bulge which in the assembly position is cross-sectionally convex toward the body to be contacted and in top view in particular is circular, or a bead projecting toward the body to be contacted. Illustratively the contact protrusion may be implemented by embossing the metal band with a bulge which is cross-sectionally convex toward the body to be contacted and which in topview in particular is circular. In this manner the - or each - contact protrusion

can be formed in especially simple manner when the device of the invention is being manufactured. When assembling the device of the invention, this contact protrusion, first being in spot form, and thereupon, with elastic deformation, in increasingly planar form, comes to rest against the body to be contacted and as a result a reliable electrically conducting connection is achieved in the desired manner. In corresponding manner, beads of arbitrary shapes may be embossed into the metal band to form contact protrusions. The contact protrusions of this embodiment consisting of embossings, openings are not required in the base structure that otherwise, in the assembly position, might admit external air and/or humidity when into the contact zone. As regards contacting pipes, the device of the invention for instance may consist solely of a clamping band, the side of this band facing the pipe to be contacted when in the assembly position comprising sealing lips. Such an embodiment is especially simple and economical to manufacture.

In another embodiment of the invention, the - or each - contact protrusion consists of a blade projecting toward the side of the base structure which in the assembly position faces the body to be contacted, the - or each - blade optionally being stamped out of the contact element in a further variant. Again this embodiment allows especially simple and economic manufacture.

In another embodiment, a portion of the contact element passes out of the base structure in its assembly position to its side facing away from the body to be contacted or the

contact element is connected in electrically conducting manner to an element passing out of this side of the base structure. In this embodiment the contact element when in the assembly position can be contacted from the outside, for instance by attaching a grounding cable to the outside element. This feature facilitates the assembly of the device of the invention.

Depending on particular requirements, the base structure of the device of the invention may assume an arbitrary design, for instance being flat or plate-shaped to connect flat or plate-shaped bodies, or being bent or curved to contact bent or curved bodies. Appropriately, to contact elongated, in particular substantially cylindrical bodies, the base structure is designed in such manner that in the assembly position it shall enclose the body to be contacted in annular form or like a bush. The base structure of this embodiment is kept especially reliably against the body to be contacted.

In another appropriate embodiment, the base structure is in the form of a clamp which can be tensioned around the body to be contacted. In this embodiment there is greater reliability yet in connecting the device of the invention to the body to be contacted and assembly is simplified further still.

As regards the two above embodiments, the - or each - contact protrusion appropriately is a radial projection.

A variant of the above embodiment, the - or each - contact protrusion runs in the circumferential direction of the base structure substantially over the full length of this

structure. As a result there is large-area contact with the body to be contacted and hence a reliable, electrically conducting connection. The large-area contact with the body to be contacted substantially negates the effects of component tolerances on the electrical connection between the device of the invention and the body to be contacted.

In another variant, at least two mutually spaced-apart contact protrusions preferably mounted along a circumferential line on the base structure and spaced apart are used. In this manner contact is set up with the body to be contacted at several circumferential sites.

In another embodiment of the invention, illustratively for contacting pipes or cables, the base structure consists of at least two mutually connectable parts which in the assembly position are consecutive along the circumference of the body to be contacted. In this embodiment the base structure consists of several segments. Illustratively the base structure may consist of two semi-annular parts.

In another and especially advantageous variant, the base structure is integral and open in the circumferential direction and is fitted at its free ends with brackets which can be joined to one another when in the assembly position. Because the base structure is integral, assembly of the device of the invention is made easier. By joining the brackets to each other, the device of the invention is affixed more rapidly and in simple manner to the body to be contacted.

The brackets may be joined to each other in arbitrary manner, for instance being welded together. However an

advantageous variant provides that the brackets shall be joined to each other by screws or a clamp. This feature further simplifies the assembly of the device of the invention. Moreover the mutual connection of the brackets and hence the connection of the device of the invention to the body to be contacted is detachable in this variant. As a result the device of the invention is optionally re-usable.

In another embodiment, the base structure comprises a part made of an elastic material with which the side facing the body to be contacted in the assembly position is connected to the contact element. If the base structure is in the form of a clamp, the elastic part will deform when the clamp is being tightened and as a result will tighten the contact element toward the body to be contacted, thereby implementing an especially reliable electrical connection to the body to be contacted.

In the above embodiment the elastic part may form a coating of the contact element, or the contact element may be imbedded at least in part in the elastic material. In order to render the device of the invention optically more advantageous and/or to protect it against ambient effects, the contact element may be fitted with a thin, optionally colored film. However the contact element also may be fitted with the said elastic material to achieve electrical insulation or be imbedded in it.

The elastic material can be selected within wide limits in relation to the particular requirements. Advantageously this elastic material shall be an elastomer, in particular a

thermoplastic elastomer. Consequently the manufacturing costs of the device of the invention are lowered. Arbitrary elastomers may be used, for instance vulcanized rubber. Because easily processable, thermoplastic elastomers are especially advantageous.

In a further variant of the embodiments comprising an elastic part, the contact element is connected to the radial inside surface of the elastic part, and a band-shaped tightening band to tighten the device of the invention around the body to be contacted is attached to the radial outside surface of the elastic part, preferably in firmly affixed manner. The clamp makes it possible to tighten the device of the invention around the body to be contacted , the contact element then being firmly pressed against this body and the elastic material between the clamp and the contact element being compressed, whereby the contact element is biased toward the body to be contacted. Because of this biasing action, reliable electrical connection between the contact element and the body to be contacted shall be achieved even when tension of the tensioning part should slacken over time.

In a variant of the above embodiment, the tensioning part is metallic and the contact element is connected in electrically conducting manner with this tensioning part. In this design, a conductor, for instance a grounding cable, can be easily connected in the assembly position of the device of the invention to the externally accessible clamping part and, as a result of the electrical connection between the clamping

part and the contact element, the body to be contacted shall be grounded in the desired manner.

In another variant, the contact element is fitted with terminals to hook up a conductor, for instance a grounding cable, in such manner that the conductor can be connected with the contact element resting in the assembly position against the body to be contacted to set up an electrically conducting connection between the conductor and the body to be grounded. The terminals facilitate hooking up a conductor, for instance a grounding cable.

As regards the embodiment of the base structure and the brackets as an integral unit, a variant of the above embodiment provides that the contact element shall constitute the brackets or extends as far as into the brackets and in that at least one aperture is present in one bracket and at least one threaded borehole in the other bracket, the borehole being opposite the aperture in the assembly position, and in such manner that in the assembly position the brackets shall be crossed by at least one preferably metallic, electrically conducting screw passing through the aperture and engaging the threaded borehole to connect the brackets to each other and to the conductor, for instance a grounding cable, the brackets thus constituting the terminals. This design is implemented in especially easy and rapid manner and therefore can be assembled economically. The conductor is hooked up in that, using at least one screw, on one hand the brackets are tightened to each other and on the other hand the conductor,

illustratively using a connecting grommet, is connected to the brackets in electrically conducting manner.

In an unusually advantageous variant of the embodiment comprising the elastic part, the elastic material at least partly consists of an electrically conducting elastic material comprising at least one protrusion constituting the contact protrusion. Because of the electrical conductivity of the elastic material the base structure illustratively may wholly consist of elastic material and consequently metal parts no longer shall be required. This feature facilitates the manufacture of the device of the invention. Recycling also is improved because the base structure is made of a single material.

In the above embodiment to achieve electrical conductivity, electrically conducting masses or particles are appropriately imbedded in the elastic material. By appropriately selecting the content of electrically conducting masses or particles in the elastic material, latter's conductivity can be selected within wide limits in relation to particular requirements.

In a variant of the above embodiment, the elastic conducting masses or particles are distributed substantially uniformly in the elastic material. In this manner the elastic material shall be uniformly conducting.

If for instance the device of the invention is to contact the outside surface of a metal pipe, it will suffice that the contact protrusion project perpendicularly to the rest surface as far as the region of this surface and rests against it in

the assembly position. If on the other hand the device of the invention makes contact with a bared coaxial-cable outer conductor radially recoiling against an insulating sheath, then the contact protrusion of the device of the invention must radially project so far that in the assembly position it shall rest against the bared outer conductor. In this respect a further variant of the invention provides that the - or each - contact protrusion projects so far beyond the rest surface in the assembly position and perpendicularly to it that in this assembly position it will come to rest against an electrically conducting segment of the body to be contacted, recoiling relative to a part of the body to be contacted against which rest the rest surfaces of the base structure. In this manner it is possible also to implement an electrically conducting contact with recessed parts of the body to be contacted.

In another embodiment, the device of the invention comprises sealing means to seal a space subtended between the body to be contacted and the device of the invention in the assembly position against penetration by air and/or moisture. This embodiment reliably prevents interference, and consequent oxidation, by air and/or moisture penetrating the contact zone at the outer surface of the body to be contacted.

In a variant of the above embodiment, the sealing means comprise elastic sealing lips at a side of the base structure facing the body to be contacted in the assembly position, said lips being mutually apart in the axial direction of the base structure and running in the circumferential direction of the

base structure and over its full length, and resting tightly against the outside surface of the body to be contacted in the assembly position. When contacting elongated, illustratively substantially cylindrical bodies such as pipes or cables using a device of the invention comprising a base structure enclosing this body in the assembly position, this embodiment reliably implements sealing and prevents air and/or moisture from entering the contact zone.

In another variant of the embodiment comprising sealing means and an integral base structure with brackets, the sealing means comprise elastic sealing surfaces constituted by the mutually facing bracket surfaces or a sealing element made of an elastic material being present between said surfaces in the assembly position, the sealing surfaces resting tightly against each other in the assembly position or against the sealing element and tightly adjoining the sealing lips in the circumferential direction of the base structure. Sealing is improved further in this manner.

In another embodiment, the contact element and/or the clamp are made of brass and/or high-strength brass and/or of low-alloyed copper. The electrical conductivity of these materials is especially good and accordingly the electrical resistance between a conductor such as a grounding cable the body to be contacted is low.

The invention is elucidated below in relation to various embodiments shown in the attached drawing.

Brief Description of the Drawings

Fig. 1 is a schematic perspective of a first embodiment of a device of the invention in the form of a clamp in the assembly position,

Fig. 2 is an axial section of the device of the invention of Fig. 1,

Fig. 3 is a schematic elevation of the radial inside surface of a device of the invention of Fig. 1,

Fig. 4 is a schematic radial section of the device of the invention of Fig. 1 in the assembly position,

Fig. 5 is a representation similar to Fig. 3 of a second embodiment of the device of the invention,

Fig. 6 is a view similar to Fig. 4 of the device of the invention of Fig. 5 in the assembly position,

Fig. 7 is a view similar to Fig. 2 of a third embodiment of the device of the invention,

Fig. 8 is a view similar to Fig. 3 of the device of the invention of Fig. 7,

Fig. 9 is a view similar to Fig. 2 of a fourth embodiment of the device of the invention,

Fig. 10 is a view similar to Fig. 4 of the device of the invention of Fig. 9,

Fig. 11 is a view similar to Fig. 2 of a fifth embodiment of the device of the invention,

Fig. 12 is a view similar to Fig. 4 of the device of the invention of Fig. 11,

Fig. 13 is a view similar to Fig. 2 of a sixth embodiment of the device of the invention,

Fig. 14 is a view similar to Fig. 4 of the device of the invention of Fig. 13,

Fig. 15 is a view similar to Fig. 4 of a seventh embodiment of the device of the invention, and

Fig. 16 is a view similar to Fig. 4 of an eighth embodiment of the device of the invention.

Detailed Description of the Preferred Embodiments

Identical or corresponding components in the Figures of the drawing are denoted by the same references.

Fig. 1 shows a device of the invention 2 comprising a flexible base structure 4 in the form of a clamp which in the assembly position shown in Fig. 1 rests against a conducting part of a body to be contacted, enclosing, like a bush, in the embodiment of Fig. 1, a bared outer conductor 6 of a coaxial cable 8. In this embodiment the base structure 4 is integral and open in the circumferential direction and comprises a band-shaped metal contact element 10 fitted with brackets 12, 14 which are substantially perpendicular to the clamp ends and which rest against each other in the assembly position. The bracket 12 comprises apertures 16, ~~apertures16~~, the bracket 14 comprises (not shown) threaded boreholes which, in the assembly position, are opposite the apertures 16 in such manner that by means of metal screws 18 passing through the apertures and engaging the threaded boreholes may connect the

brackets 12, 14 in the assembly position can be connected to each other and with a conductor, illustratively in this embodiment a grounding cable denoted by 20.

Moreover the base structure 4 comprises a part 22 made of an elastic material, for instance an elastomer, in particular a thermoplastic elastomer.

Fig. 2 shows that the elastic part 22 constitutes a radial outside surface 24 of the base structure 4 and that the contact element 10 is imbedded by its axial edges 26, 28 into the elastic material of the part 22. Sealing lips 30, 32 mutually apart in the axial direction of the base structure 4 are formed by the elastic material of the part 2 on the side 92 of the base structure 4 - in this embodiment at its radial inside surface - which in the assembly position faces the body to be contacted, and additional sealing lips 34, 36 are formed each axially external to the sealing lips 30, 32. Because not shown in the drawing, it is stressed here that the sealing lips 30, 32 and also the additional sealing lips 34, 36 substantially run over the full length of the base structure in its circumferential direction and, for the assembly position of the device 2 shown in Fig. 1, will tightly rest against the sheath of the coaxial cable 8. They seal a space subtended in the assembly position of the device of the invention 2 shown in Fig. 1 of the device of the invention 2 between the base structure 4 and the coaxial cable 8 to be contacted, subtending a contact zone 38 wherein an electrically conducting connection between the device of the

invention 2 and the outer conductor 6 of the coaxial cable 8 is implemented.

To implement an electrically conducting connection between the device of the invention 2 and the outer conductor 6 of the coaxial cable 8 to be contacted, the device of the invention 2 is fitted with contact protrusions of which Fig. 2 only shows one denoted by 40. Seen in cross-section, the contact protrusion is convex relative to the coaxial cable 8, while in top view it is substantially circular.

The device of the invention 2 operates as follows:

In order to implement an electrically conducting connection between the outer conductor 6 of the coaxial cable 8 to be contacted and the grounding cable 20, the device of the invention 2 is placed around a bared zone of the coaxial cable 8 and is tightened by the screws 18. In the process, the base structure 4, by means of rest surfaces 42, 44 constituted by the sealing surfaces of the sealing lips 30, 32, comes to rest against the sheath of the coaxial cable 8. The contact protrusion 40 projects perpendicularly to the rest surfaces 42, 44, that is in a direction symbolically denoted by an arrow 46 in Fig. 2, in the assembly position, so much beyond the rest surfaces 42, 44 that, in this assembly position, it comes to rest against the outer conductor 6 of the coaxial cable 8 which is radially recoiling, and an electrically conducting connection has thus been implemented between the contact element 10 and the outer conductor 6. Because the grounding cable 20 is connected though the screws 18 to the contact element 10, the desired electrically

conducting connection has been set up in this manner, and the outer conductor 6 is now grounded.

The contact protrusion 40 is elastically deformed during tightening of the base structure 4 so that this protrusion rests in resilient manner against the outer conductor 6 of the coaxial cable 8. In this manner reliable electrical connection between the grounding cable 20 and the outer conductor 6 is now secured.

Because the contact protrusion 40 is a part of the base structure 4, a separate element, for instance an adapter, no longer is required. This features simplifies the design of the device of the invention 2 and makes its manufacture more economical.

Fig. 3, an elevation of the radial inside surface of the base structure 4, shows that the contact protrusion 40 and a further contact protrusion 48 consist each, as seen in topview, of a circular salient formed in the contact element 10.

Fig. 4 is a schematic, radial section of the device of the invention 2 and shows that, besides the contact protrusions 40, 48, another contact protrusion 50 is present and that the contact protrusions 40, 48, 50 are mutually equidistant in the circumferential direction of the base structure 4.

Fig. 5 is an elevation of the radial inside surface of a second embodiment of the device of the invention 2 differing from that of Fig. 1 in that the contact protrusions consist of blades 52, 54 stamped out of the contact element 10.

Fig. 6 is a radial section of the device of the invention of Fig. 5 and shows that besides the blades 52, 54 another blade 56 is present, the blades 52, 54, 56 being equidistant from each other in the circumferential direction of the base structure 4 and are bent toward the side of the base structure 4 facing the outer conductor 6 to be contacted in the assembly position and project so much that they rest resiliently against the outer conductor 6.

Fig. 7 is an axial section of a third embodiment of the device of the invention 2 differing from that of Fig. 1 in that the salient in the contact element 10 forming the contact protrusion consists of a bead 52 running in the circumferential direction of the base structure 4 substantially over the entire length of the base structure 4 in that direction. The elastic part 22 tightly rests against the contact element 10 in the zone of the bead 58.

Fig. 8 is a schematic elevation of the radial inside of the device 2 of Fig. 7.

Fig. 9 is an axial section of a fourth embodiment essentially differing from that of Fig. 7 in that the elastic part 22 is mounted a distance away from the contact element 10 in the zone of the bead 58.

Fig. 10 shows a radial section of the device of the invention 2 of Fig. 9.

Fig. 11 is an axial section of a fifth embodiment of the device of the invention 2 differing from the above embodiments in the first place in that the contact element 10 consists of a flat, that is unembossed, metal band. The base structure 4

is fitted at its elastic part 22 with a radial protrusion 62 for the purpose of forming a contact protrusion 60, the contact element 10 being affixed to the radial inside surface of the protrusion 62 and in this manner forms the contact protrusion 60. In this embodiment the base structure 4 furthermore comprises a metal tensioning element 64 connected to the radially outside surface of the elastic part 22 to tension the device of the invention 2 around the body to be contacted. By means of an adapter 66 leading to the radially outside surface of the base structure 4, the contact element 10 is electrically connected to the tensioning element 64. The adapter 66 connects the grounding cable 20 to the contact element 10. When tightening the device of the invention 2 around the outer conductor 6 of the coaxial cable 8 to be contacted, the contact protrusion 60 of the contact element 10 is firmly compressed against the outer conductor 6 and the elastic part 22 is compressed as well, thereby forming spring means to bias the contact protrusion 60 toward the outer conductor 6.

Fig. 12 is a schematic radial section of the device of Fig. 11.

Fig. 13 shows a sixth embodiment of the device of the invention which differs from that of Fig. 12 in that the ends 68, 70 of the contact element 10 pass out of the base structure 4 in the vicinity of the brackets 12, 14, as a result of which the grounding cable 20 can be connected to the ends 68, 70 of the contact element 10.

Fig. 14 is a schematic radial section of the device of Fig. 13.

Fig. 15 shows a seventh embodiment similar to that of Fig. 14 wherein merely one end 68 of the contact element 10 passes out of the base structure 4.

Lastly Fig. 16 shows an eighth embodiment similar to that of Fig. 12 wherein the one end 68 of the contact element 10 runs radially outward through the part 22 to the tensioning element 64 and in this manner is connected in electrically conducting manner to the tensioning element 64.

While this invention has been described as having a preferred design, it is understood that it is capable of further modifications, and uses and/or adaptations of the invention and following in general the principle of the invention and including such departures from the present disclosure as come within the known or customary practice in the art to which the invention pertains, and as may be applied to the central features hereinbefore set forth, and fall within the scope of the invention or limits of the claims appended hereto.